Important Advances in Clinical Medicine

Epitomes of Progress—Nuclear Medicine

The Scientific Board of the California Medical Association presents the following inventory of items of progress in nuclear medicine. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and important clinical significance. The items are presented in simple epitome and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist the busy practitioner, student, research worker or scholar to stay abreast of these items of progress in nuclear medicine which have recently achieved a substantial degree of authoritative acceptance, whether in his own field of special interest or another.

The items of progress listed below were selected by the Advisory Panel to the Section on Nuclear Medicine of the California Medical Association and the summaries were prepared under its direction.

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Oral Contraceptives, Hepatic Adenomas and Liver Scans

SEVERAL RECENT REPORTS link oral contraceptive steroids (OCS) to the formation of benign hepatic adenomas in young women. Although histologically benign, the variable clinical course includes spontaneous rupture and hemoperitoneum. This catastrophic event, when not immediately fatal, substantially increases the surgical mortality. Liver scanning with multiple agents is an important modality in the noninvasive diagnosis of these lesions.

The usual liver scan using a colloidial agent is the first scan which should be done. This scan shows the distribution of reticuloendothelial cells. Hepatic adenomas consist of sheets of hepatocytes and do not contain Kupffer cells. The colloid scan will show tumors which are at least 2 cm in size as defects or holes in the liver. This study should be done on patients at risk with an enlarged, painful or tender liver. It might even be considered as part of the periodic evaluation of patients on a long-term regimen of OCS.

Two other scans which are helpful in the detection of these tumors are gallium citrate Ga 67 and ^{131}I rose bengal. When yielding abnormal findings, they lend same specificity to the lesions seen on colloid scans. The hepatocytes of the benign adenoma may be sufficiently differentiated to concentrate rose bengal. Soon after injection, the radioactivity clears from the normal liver parenchyma via the biliary system. Due to the absence of biliary radicles in the adenoma, the rose bengal is not cleared and delayed scans may show radioactivity in the cold area of the colloid scan.

Gallium is taken up by normal hepatocytes to a limited degree. Notably abnormal cells with a high lysosomal activity as found in the malignant forms of primary liver tumor concentrate gallium in greater amounts. Benign hepatic adenomas, although containing some gallium, usually have a lower concentration and appear as cold defects in the liver which can differentiate them from the malignant forms.

Therefore, the constellation of findings in a patient on OCS pointing towards the diagnosis of benign hepatic adenoma are cold defects on a colloid liver scan which show no significant gallium concentration but retain rose bengal.

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Myerson P, Prokop E, Sziklas JJ, et al: Scan findings in hepatic adenoma (focal nodular hyperplasia). Clin Nucl Med 1:108-112, Aug 1976

Radionuclide Techniques for Detection of Occult Abscesses

THE DIAGNOSIS of occult abscess is still a clinical enigma. Various isotopic techniques including static imaging and dynamic flow studies have been used with variable results. Combined liver-lung scans are used to detect subphrenic abscesses but are unreliable in the presence of ascites and basilar lung diseases. Blood pool agents may outline larger abscesses as avascular masses. This method, however, lacks sufficient sensitivity.

Recently, leukocytes labeled with chromium 51 (^{51}Cr), technetium Tc 99m sulfur colloid (^{99m}Tc-SC) and gallium citrate Ga 67 (^{67}Ga) have been used. ^{51}Chromium-labeled leukocytes produce images that are less than ideal due to the intense background activity resulting from margination of leukocytes along the vessel walls. ^{51}Cr labeling may also impair leukocyte function. ^{67}Ga-labeled leukocytes will localize in abscesses which are only 3 to 14 days old. Advantages of ^{67}Ga-labeled leukocytes are that incisional abscess can be detected and there is less background activity in the reticuloendothelial system making abdominal lesions more apparent. However, low count rates and nonspecific labeling restrict its clinical usefulness. ^{99m}Tc-SC-labeled granulocytes offer some promise since they are viable *in vivo* and retain both chemotactic and phagocytic properties. This technique is sensitive but gives false positive results in the presence of thrombi. ^{99m}Tc-SC-labeling allows early scans to be done, which is a benefit in extremely ill patients.

Gallium citrate Ga 67-scanning is the most common and tried isotope procedure for the detection of inflammatory lesions. Scans done at 24 to 72 hours will show most of the active infections. Unlike the localization of gallium in tumors, concentration in abscesses occurs rapidly allowing scans to be done as early as two to four hours after injection. The early scans have the added advantage of minimal gallium excretion in the colon making it easier to detect abdominal lesions. The uptake of gallium by abscesses is dependent on the inflammatory activity and number of leukocytes. The concentration diminishes with response to chemotherapy. The state-of-the-art when searching for obscure infections is to do early (about 4 hours) scans followed by delayed images. A positive study, however, is nonspecific and abnormalities will be seen in tumors, granulomas and surgical wounds. Clinical correlation is necessary to differentiate among these possibilities.

The gallium citrate Ga 67-scan still remains the most popular technique. Leukocyte labeling is highly technical and still in the experimental stage. It is possible that combined studies using gallium citrate Ga 67 and labeled leukocyte will eventually be the preferred approach in achieving maximum sensitivity and specificity.

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Large-Field versus Conventional Scintillation Cameras

SODIUM IODIDE SCINTILLATION CRYSTALS, the core of detector systems in nuclear medicine, are produced by "growing" them from their center. Their size is restricted by the expense of the manufacturing process and the frequent appearance of defects with increasing size. In the past ten years, scintillation cameras used clinically have been limited to crystals with an effective viewing area of about 10 inches in diameter. Recent advances in crystal technology, however, have enabled manufacturers to make available commercially scintillation cameras with a field of view of up to 15 inches.

In comparison with conventional scintillation cameras, large-field scintillation cameras have substantially increased sensitivity for equivalent amounts of radioactivity, with only a minimal sacrifice of resolution (pictorial detail). Large organ areas, such as both lungs or liver and spleen together, can be visualized on a single image with better sensitivity and resolution than with the older devices. The large-field cameras are particularly suited for ventilation studies with radioactive gas. These have to be done during